

A Space Blockade; Flexible and Responsive Denial of Adversary Use of Space

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Introduction

From the earliest days of space exploration, space has been used for military purposes. This use has ranged from imagery for reconnaissance, such as the recently declassified Project Corona¹, weather, and terrain mapping to long range communications and the more recent innovations from precision navigation.

Over the past few decades, space has proven itself a superior force multiplier. America's extensive investments in military space systems paid off demonstrably in OPERATION DESERT STORM² and OPERATION ALLIED FORCE.³ The Department of Defense Space Policy calls space a 'strategic enabler' and calls it a necessary precursor to the way we fight wars on land, at sea, and in the air.⁴

We have, perhaps, reached the point where we take the need for space support in battle as a given. But if it is so obvious to us that we need space to fight, what must the rest of the world be thinking? There is nothing uniquely American about space that prevents the rest of the world from learning from our example.

Space Threat

Just as the world has transitioned from bipolar to multi-polar with the demise of the Soviet Union, space systems and services have spread across the globe. Where once space systems could be classed as American or Soviet, now they come in a bewildering array of national, corporate, and consortium owners. Satellites and launch services are for sale, and if a nation cannot afford their own system, then the data from another's is available at a price. Having demonstrated the utility of space services in war, the United States must prepare to face a future in which its adversaries pursue the same advantage.

Imagery

Space holds some significant advantages for intelligence gathering. A satellite's ability to over fly any point on the globe and return images of the surface creates a nearly transparent battlefield to its user. This data ranges from simple terrain mapping for mission planning, to target identification and force tracking. In particular, the ability to monitor an adversary's troop movements behind his lines allows a military commander to anticipate adversary action and minimize surprise.

Satellite imagery is no longer the sole province of world super-powers. Many nations either have or are developing their own satellite imagery capability. Along with the U.S. and Russia, these include Japan, China, India, Israel, Brazil, Canada, Great Britain, and France.⁵ Several commercial companies are also developing satellite imagery for sale to anyone with the funds to buy an image.

In 1967, Corona was producing imagery with a resolution of about 2.7 meters.⁶ This was considered to be so militarily significant that it was buried under heavy classification. Today, 1-meter imagery is the commercial standard available worldwide.

Weather

Space based weather data and information has become a staple of modern existence. United States weather systems (TIROS and GOES) broadcast un-encrypted data to anyone desiring weather imagery. If collection, processing and interpretation is too difficult or simply inconvenient, then for the price of a subscription to cable TV, a full time weather channel can be acquired which will provide not only continuous weather imagery, but world-wide weather analysis and forecasts. To further complicate matters, regional and local weather data and information is continuously available on the Internet.

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| 14. ABSTRACT From the earliest days of space exploration, space has been used for military purposes. This use has ranged from imagery for reconnaissance, such as the recently declassified Project Coronal, weather, and terrain mapping to long range communications and the more recent innovations from precision navigation. Over the past few decades, space has proven itself a superior force multiplier. America's extensive investments in military space systems paid off demonstrably in OPERATION DESERT STORM2 and OPERATION ALLIED FORCE. The Department of Defense Space Policy calls space a "strategic enabler" and calls it a necessary precursor to the way we fight wars on land, at sea, and in the air. We have, perhaps, reached the point where we take the need for space support in battle as a given. But if it is so obvious to us that we need space to fight, what must the rest of the world be thinking? There is nothing uniquely American about space that prevents the rest of the world from learning from our example. | | | | | |
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As a result, military planners must assume that all parties to any action have good data about theater, regional, or local weather phenomena. Further, planners must assume that accurate analysis of climatic conditions like: Cloud cover, ambient temperature, relative humidity, rain/snow intensity and depth, wind, soil moisture content, sea states, etc. are presented and forecast for even non-nation state actors.

Communications

The utility of space-based communications has been intuitively obvious since before we were able to place objects in orbit. Further, space-based communications has been one of the (relatively) easiest technologies to develop for space. As a result, there has been a proliferation of space communication services.

Almost every nation now either owns or leases dedicated satellites for communications. Even small countries like the Philippines have dedicated ground stations and satellites - albeit American made. Several companies like Hughes and Matra-Marconi have had the capability to develop a non-nation state consortium to provide space based communications. However the credit for the first international, non-nation sponsored space based communication system goes to Motorola for the Iridium Constellation. While unable to remain financially solvent, the Iridium constellation proved it was possible for a consortium of companies to design and deploy a satellite constellation.

With the advent of man-portable (and in some recent cases, handset sized) satellite communications links, these provide the military commander a means of communications with his troops that can no longer be stopped by bombing a central ground station. Each individual handset would have to be hunted down and destroyed.

Precision Navigation

Warfare has always been controlled by three simple questions: "Where am I?"; "Where are my buddies?"; and finally, "Where are the bad guys?" Not coincidentally, these questions have historically been hard to answer. With the advent of space-based navigation, supported by reliable surveillance and communications (also space based as discussed above), these questions are rapidly answered.

Navigation is the precision blending of positioning and timing. GPS provides timing information accurate to 1 millionth of a second. With selective availability turned off GPS positioning information is now good to approximately 3 meters. This provides an exceptionally accurate answer to the first of our three simple questions above. With good communications, it answers the second as well.

As we have already addressed, imagery, weather and communications are available to anyone with money. The U.S. Global Positioning System (GPS) is now also available to anyone – un-encrypted. Many companies produce GPS receivers capable of accuracy adequate for almost any form of fire control, fixed site survey, guided munitions, or troop movement through unfamiliar terrain. Linked with commercial autopilots, it could even be used to manufacture crude cruise missiles.

There has also been a push for the providers of Personal Communication Services (PCS) – Cell Phones, whether terrestrially or space based, to provide the capability to locate a cell phone in use. The rationale for PCS location services revolves around the ability to respond to an emergency call, and the need to know where the cell phone is to some degree of precision. Most of the major cell phone manufacturers have concepts that would support this desired capability. While some of them use a GPS receiver in the phone that re-transmits its location, others are considering an independent timing and positioning signal. So it is conceivable that an alternate navigation capability will be developed by the communications industry.

The U.S. GPS system is not the only navigation system available. The Russian GLONASS system remains on orbit and the European Space Agency is proposing to launch its own navigation system, Galileo.

GLONASS is the Russian satellite constellation designed to provide exactly the same capability to the former Soviet Union and Warsaw Pact forces that GPS provided to U.S. and allied forces. GLONASS is less accurate for both

timing and positioning. However it is more than sufficient for most military applications. Like GPS, it provides an un-encrypted signal that can be used by anyone with an appropriate receiver.

Galileo is the proposed European space based navigation system. If implemented, it would have capabilities roughly equivalent to the current GPS system. The advantage of Galileo from the European perspective is that it would not be under U.S. government control.⁷

The Rise of Commercial Space Systems

In May of 1998, the aggregate number of commercial space assets finally exceeded the aggregate number government space assets. Up until that point, governments had been the principle owners, operators and users of space. But May 1998 marked a milestone in the coming of age of commercial space activities.

With government space systems, there are typically two fundamental approaches for their use. The first is "No Commercial Access." As with surveillance and some communications, these were government only systems used by very specific government agencies. In many cases they were not only not available for commercial exploitation, they were also not available to all parts of the government. The second is the "Public Utility" model. Weather, navigation, and some low-resolution imagery systems have followed this approach. Fundamentally, anyone who wants to receive and process this information is authorized to do so, often with no charge.

The commercial sector has different motivation: to make money. Since it is difficult to do this if you either do not allow any information access, or if you simply give it all away, Industry has taken a third approach: Fee for Service. Like free enterprise anywhere, there are very few constraints on this. This opens the door to military space for nearly every nation in the world. They no longer need to build, launch, and operate their own satellites. Instead, they can buy what they need from commercial providers ranging from individual 1-meter images over the Internet⁸ to entire ground processing stations for imagery. They can buy a single link, a whole transponder, or an entire communications satellite all without any research and development on their part.

The Problem?

So What?

So an adversary can use space. What is the impact to American military operations? Adversary use of space can have some severe impacts.

Adversary access to satellite imagery, particularly to 1-meter resolution imagery has a two-fold impact on US forces. First, it eliminates or greatly reduces our ability to act without adversary knowledge.

This is important, because surprise has historically been a large factor in America's military victories and in reducing US casualties. A recent National Defense University study looked at the 16 major conflicts the US has been involved in during the 20th century. The study showed that with surprise, the US had an average casualty ratio of 1 US soldier killed or wounded to 14.5 enemy soldiers. Without surprise, the average fell to 1 to 1.7.⁹

Second, it allows an adversary to see our force deployments and determine when and where to strike for the most effect. It allows an adversary's planners to see where we have concentrated our forces and it aids in identifying weaknesses or choke points for strike.

Operation DESERT STORM holds a prime example of such an opportunity. A dearth of available airstrips forced the Coalition to pack extremely large numbers of aircraft onto relatively small tarmacs. After the war, Gen Norman Schwarzkopf observed, "We'd jammed so many aircraft into Riyadh ... that it looked like the deck of an aircraft carrier ... Every time flew into or out of that airport I'd think, 'If one enemy aircraft were to get through and hit this place...' The secondary explosions alone would have destroyed the entire fleet."¹⁰ A massive Scud barrage could have had the same effect if focused on the airfield.

Second only to imagery is an adversary's ability to communicate via satellite links. At first glance this seems of lesser importance, as the US will likely face a future adversary on his home ground or in relatively small theater of operations. This would allow an adversary to use ground line and line-of-sight radio transmissions to communicate with his forces. There is no initial need for satcom links.

Such a static view overlooks that the battlefield is a dynamic environment. The influence of US strategy must be considered as well

The heart of the USAF's current philosophy of 'strategic paralysis' is attacking the mind of the enemy commander. This is done, not by attempting to kill him, for another would take his place, but by generating surprise and confusion by eliminating his ability to talk to his troops.¹¹

Distributed satellite communications, like that emerging today, would give an adversary a means of communicating that, unlike land lines and terrestrial radio and microwave transmissions, is virtually impossible to stop on the ground. Instead, the ability to link through the satellite itself must be eliminated. Without this, the US will not be able to conduct classic strategic paralysis campaigns against an adversary with national or even commercial satellite communications access. This would allow an adversary to maintain his situational awareness and make more casualty intensive force-on-force military engagements more likely.

Lastly, precision navigation would give an adversary two advantages. First, it allows him to conduct precision maneuvers in unfamiliar territory. This reduces the fog and friction faced by the adversary field commander. The second, and more dangerous, issue is that, linked with good intelligence, it allows an adversary to employ precision strikes against US forces. These can range from traditional precision munitions to improvised GPS guided munitions like the 'cruise missile' aircraft mentioned earlier. Even knowing precise launch points would greatly improve the accuracy of adversary short-range missiles and artillery.

What Should We Do?

Given the potential for military use of space by an adversary, what can or should the U.S. do about it? President Clinton's National Security Strategy is clear on the subject. It states that we will "maintain the ability to counter space systems and services that could be used against our ground, air, and naval forces, our command and control system, or other capabilities critical to national security."¹² Further, in the President's National Space Policy, the Department of Defense is specifically directed to "counter(ing), if necessary, space systems and services used for hostile purposes."¹³

Obviously, the decision to keep an adversary from exploiting space against us has already been made, at least in theory. The question has long been "Is it necessary?" As discussed earlier, the rise of readily available commercial and third party services has placed space within the reach of nearly any potential adversary. The question now then, is not "Is it necessary?"... It is. Rather, the question is "How should we go about doing it?"

Military doctrine for countering adversary space access is still in its infancy. Joint Publication 3-14, Tactics, Techniques, and Procedures for Space Operations separates the problem into two parts. The first, negation, concerns actions to stop adversary use of their own space systems. These include efforts to deceive, disrupt, deny, degrade, or destroy adversary owned space systems. The second, prevention, concerns stopping adversary use of US or third party space systems. Prevention ranges from diplomatic efforts to military action.¹⁴ Unfortunately, 3-14 is still in draft form, where it has been for the past 10 years.

Air Force doctrine for space has been approved and published. Air Force Doctrine Document 2-2, Space Operations was approved in August of 1998. In it, the Air Force describes what it calls offensive counterspace as actions to "destroy or neutralize an adversary's space systems or the information they supply." It does not address actions to deny access to third-party space systems."¹⁵ AFDD 2-2 is currently under revision and at this time includes wording expanding offensive counterspace to include third party, commercial, and US space systems.

While each of these documents describe what needs to be accomplished, for the most part, they stop there. Nowhere is there a consistent framework under which offensive counterspace can be applied. They all simply state that

offensive counterspace needs to be accomplished and that systems must be developed to do so.

The proliferation of commercial and third party space systems leads to two dilemmas. First, what, if anything is the proper response to an adversary's use of commercial, consortium, or third party space services? While it is clear in order to deny an adversary access to space services, a very large number of systems must be targeted. In many, if not most, cases, those systems will belong to someone other than our adversary. Obviously the US cannot simply destroy third party and commercial satellites. In addition, the ever-increasing number of systems would lead to a ridiculously large and expensive force structure to be able to deny all access within a theater of operations. So, how can the US both deny access to an adversary and keep the space control budget within the realm of sanity? By instituting and enforcing a space blockade.

The Answer? A Space Blockade!

What is a space blockade? In the purely naval sense a blockade is "a belligerent operation intended to prevent all vessels of all states from entering or leaving specified coastal areas which are under the sovereignty, under the occupation, or under the control of an enemy."¹⁶ Expanding the definition into the air, it is "a belligerent operation to prevent vessels and/or aircraft of all nations, enemy as well as neutral, from entering or exiting specified ports, airfields, or coastal areas belonging to, occupied by, or under the control of an enemy nation. A belligerent's purpose in establishing a blockade is to deny the enemy the use of enemy and neutral vessels or aircraft to transport personnel and goods to or from enemy territory. The belligerent right of blockade is intended to prevent vessels and aircraft from crossing an established and publicized cordon separating the enemy from international waters and/or airspace."¹⁷ In a more general sense, it is "the closure of an area, as a city or harbor, by hostile forces so as to prevent entrance and exist of traffic and communication."¹⁸ This can include both military and commercial traffic.¹⁹ So, the historical definition of a blockade can be said to cover actions on land, at sea, and in the air.

This reasoning can be readily expanded to space as well. Historically, the definition and application of blockades has often been subject to evolution to fit changing times.²⁰ By extrapolation, a space blockade is a belligerent operation to prevent access to space services, both neutral and enemy, within an area under enemy control. Unlike traditional naval or air blockades, the laws of orbital mechanics make it nearly impossible to stop a satellite from over-flying a specific area without destroying it. While it is possible to turn an aircraft or ship around and force it to leave the blockaded area, little short of destruction can stop a satellite from continuing on its orbit. Extensive orbital maneuvers can delay over-flight for a time, but at significant cost to the satellite's usable lifespan. As mentioned previously, there will be many cases where the unilateral destruction (or degradation from maneuver) of a third party satellite is not in the US's best interests.

However, unlike in terrestrial conflict, in space, denial of services does not necessarily require preventing physical movement. The communications satellite that does not (or can not) transmit and the imagery satellite whose shutter remains closed (or is blinded) is providing no more support to an adversary than one that has been destroyed. The goal, then, of a space blockade, is not to bar physical passage, but to deny an adversary any information from the system.

In conducting a blockade, a nation does not need to field enough forces to destroy every potential violator, on land or at sea, simply enough to make it 'dangerous.'²¹ Instead, a blockade often relies on deterrence to keep third parties from attempting to violate it. Indeed, the precedent for preventing neutral third party access, particularly commercial access, to an adversary dates as far back as 1584 AD.²²

The military forces present might not be enough to stop a mass attempt to run the blockade, but no one nation or company is willing to bet that its ship or aircraft will not be one of the ones intercepted. This neatly solves the force structure cost problem of offensive counterspace. The US need not field enough counterspace systems to deny or destroy every potentially threatening space system. It need only have an open and credible deterrent force, to include both detection and denial systems, and sufficient forces to deny or destroy any adversary owned and operated space systems.

Space Blockade Process

How then, would a space blockade operate? Blockades in general have many steps in common. A space blockade would run in five, sometimes overlapping, phases:

1. Blockade Declaration *(Tell 'em)*
2. Deployment of Forces *(Weigh Anchor)*
3. Voluntary Compliance *(Watch For Blockade Runners)*
4. Reversible Enforcement *(Board and Turn Back)*
5. Lethal Enforcement *(Sink 'em)*

Blockade Declaration

As in any blockade, before enforcement can begin, it must be announced. Historically, the announcement also contains the information necessary to remain clear of the blockade; start date, geographic area covered, and any exceptions or variations to a total blockade.²³ This allows third parties the opportunity to remove themselves from the blockaded area and remain neutral. In a space blockade, this announcement must include what sorts of systems are covered (is it just an imagery blockade, a communications black-out, a total space ban...), and what would be an acceptable means of showing inactivity (shutters closed, optics turned away from the Earth, no transmissions into the blockaded area...). It should also be noted that exceptions would likely have to be made to allow communications neutral embassies.

Deploy Forces

Along with declaring the blockade, the United States will have to deploy forces to enforce it. Unenforceable, or 'paper' blockades have long been considered invalid.²⁴ It is not sufficient for the US to simply demand that neutral parties cease providing space services to an adversary simply because the US wishes it so. The US must field forces to enforce the blockade.

These forces need not be space-based themselves. In fact, a breadth of different systems for different situations would be preferable. These systems should range from reversible, non-damaging systems to the capability to destroy both space and ground segments. The US already has the capability to destroy ground sites within adversary territory through airpower. Air Force Space Command's Strategic Master Plan lists several candidate systems for the remaining forces:

| | ISR | | COMM | | NAV | |
|------------------------------|-----|----|------|----|-----|----|
| | REV | HK | REV | HK | REV | HK |
| Mobile RF Jammer | | | X | | | |
| Laser Blinder | X | | | | | |
| Navigation Jammer | | | | | X | |
| Downlink Mission Data Jammer | X | | X | | | |
| Counterspace Microsats | X | X | X | X | | |
| Space-Based Laser | | X | | X | | X |

Source: AFSPC Strategic Master Plan for FY02 and Beyond

Table 1

These systems would provide a broad spectrum of reversible and lethal options for blockade enforcement.

Voluntary Compliance

The best possible outcome is that third parties choose to comply voluntarily with the blockade. Voluntary compliance could be pursued through regulatory, diplomatic, or economic means depending on the ownership of the system in question.

Regulatory actions could be levied upon US owned corporations providing space services. By using the Federal government's authority to license and regulate commerce, US companies could be induced agree to comply with any space blockade as a precondition to approval to operate. Such actions are being debated right now for the space imaging field. Called shutter control, the Federal government is considering placing exactly these sorts of restrictions on US imagery firms in order to prevent their products from being used against US national interests.²⁵

Diplomacy could be used to prevent foreign nations from providing space support to an adversary during conflict. The State department must be prepared to explain to foreign nations why blockade compliance is in their own best interests. Since many foreign space systems are actually owned by consortiums of nations, this may prove a daunting task. For example, during OPERATION ALLIED FORCE in Kosovo, it took extensive diplomatic pressure to arrange for Eutelsat, an international consortium, to cut off Serbian satellite television propaganda broadcasts²⁶... and the primary members of Eutelsat (England, Germany...) were our allies in the conflict!²⁷ This underscores the difficulty of using diplomacy to rapidly affect international consortia.

Lastly, economic means could be employed to secure the cooperation of third party space service providers. These could be as simple a reminder of the value of the space assets at risk and the potential loss to buying all of the transponder time on a communications satellite or reimbursement for estimated lost revenue due to the blockade.

The effectiveness of all three methods would be greatly enhanced by the presence of fielded forces capable of conducting military operations to enforce the blockade. The presence of this 'stick' would strengthen the US's hand for negotiations and add a sense of urgency currently missing in such deliberations.

Reversible Enforcement

Lethal force is rarely the first option used when enforcing a terrestrial blockade. In terrestrial blockades, the first response is to attempt to turn back or capture the breaching party. While this is exceedingly difficult to do physically in space, the use of reversible counterspace means followed by a warning to the parties involved could be an acceptable substitute.

The key to this phase is proportionality. Lethal force is withheld when there are less harmful means of enforcement. Since a satellite cannot be easily physically stopped or captured, another means of non-lethal enforcement should be used where possible. Since this phase presupposes that efforts to obtain voluntary enforcement have failed, all that remains is military enforcement.

Once US space surveillance or intelligence systems detected a breach of the blockade, reversible systems could be employed. Once the service has been temporarily disabled, then the US would issue a warning to the party committing the breach, emphasizing the US's resolution to enforce the blockade and warning of more lethal enforcement if they continue to try to breach the blockade.

Reversible space control systems, like those listed in Table 1 would give the US a means to enforce a space blockade through temporary denial. This capability to 'turn back' blockade violators without destroying or permanently damaging their extremely expensive space systems would allow the US to show its intent to enforce its blockade without necessarily creating a major international incident.

Lethal Enforcement

However, if a third party fails to abide by the blockade following reversible enforcement, then the US must retain the option of more permanent enforcement. Just as in a terrestrial blockade, if the breaching party fails to comply

following less lethal measures, such as an order to turn about, then more lethal methods must be employed. In a space blockade, this would likely be the physical destruction of the satellite.

Attacking the satellite instead of a ground site is more attractive for two reasons. First, the principle of proportionality still holds. It is far preferable to strike an unmanned satellite in orbit than to risk killing civilians in a strike on ground facilities. The recent events in OPERATION ALLIED FORCE bear this out. Currently Human Rights Watch has laid accusations of war crimes against the NATO allies for bombing Serbian satellite television transmitters to stop propaganda broadcasts. They claim the deaths of the civilian personnel working there were not justified by the military utility of the target.²⁸ An attack on a satellite does not risk human lives, civilian or military.

Second, for many third parties imagery systems, the ground site is located in allied or neutral territory. Physical destruction of such a site could be construed as an act of war against their host country. This would likely embroil the US in additional conflicts or diplomatic emergencies that it neither needed nor wanted.

In closing it is important to note what this paper is and is not. It is a military analysis of an essentially military problem. It is not a legal review of the concept of a space blockade, nor is it a complete analysis of its ultimate political viability. It is readily apparent that, in order to protect its forces in times of war, the US must be able to deny an adversary the benefits derived from space systems. While simply destroying them, either in space or on the ground may suffice for indigenous space systems, most of the US's potential adversaries will likely use commercial services to varying degrees. A space blockade provides a reasonable framework for cutting them off from such support with minimum damage to the third party providers.

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⁸ See www.terraser.com for an example

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¹⁰ Ibid.

¹¹ See Major David S. Fadok's John Boyd and John Warden: Airpower's Quest for Strategic Paralysis and LtCol Norman B. Hutcherson's Command & Control Warfare, both from Air University Press, for more detailed treatments of this approach to warfare.

¹² The White House, A National Security Strategy For A New Century, October 1998, p. 26

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